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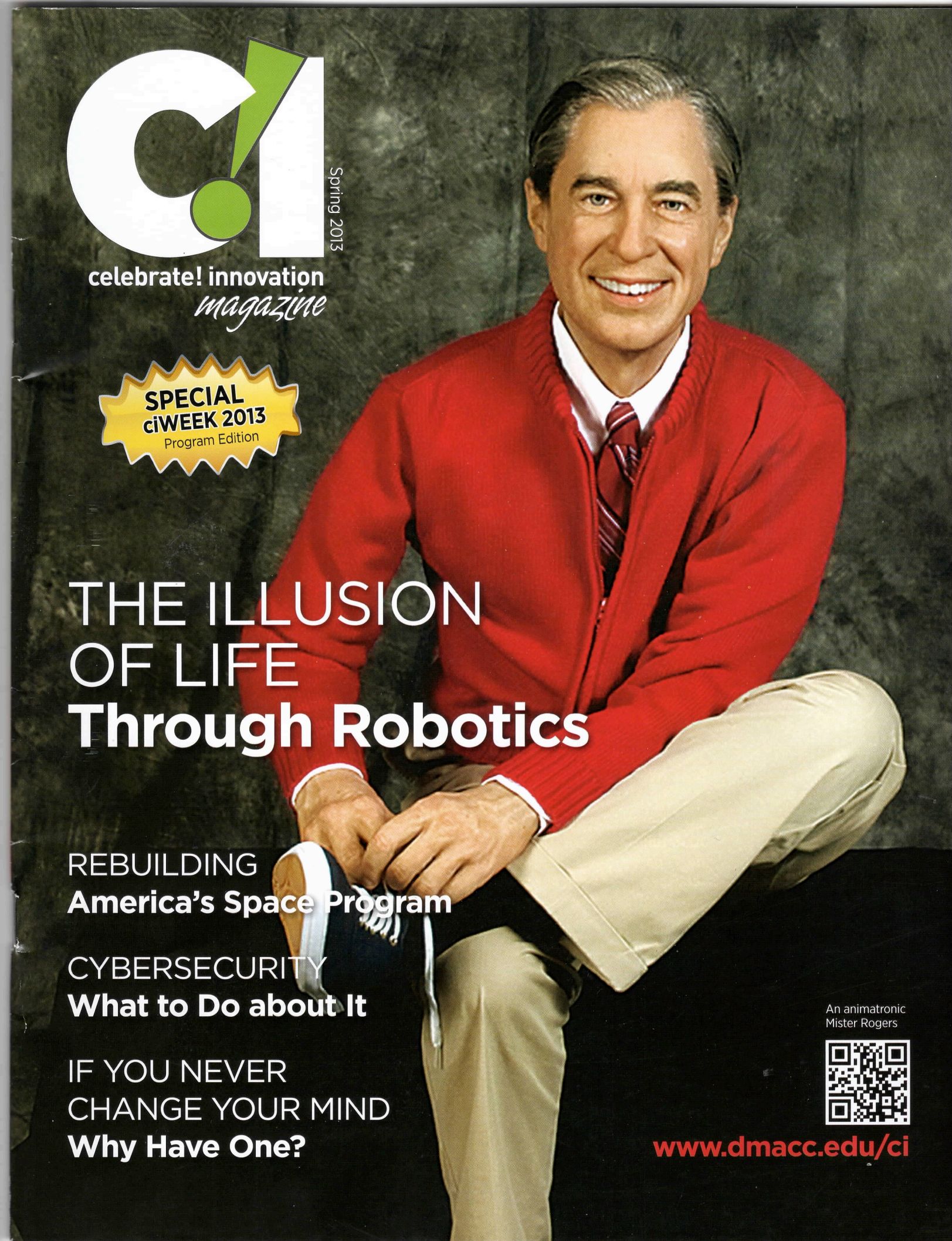
Short Description:

A concise, student-oriented adaptation of Dr. Gene W. Poor's *The Illusion of Life*, presenting core ideas behind lifelike robotics, character design, and creativity.

Summary / Subject:

This magazine feature distills Dr. Gene W. Poor's influential book *The Illusion of Life* into a concise, youth-focused article designed for students and emerging creators. It explores the principles behind lifelike robotics, blending engineering, sculpture, storytelling, and imagination to bring characters to life. Celebrate Innovation Magazine highlights Poor's message that lifelike animation is driven not only by mechanical technique but by creative vision and narrative purpose, inspiring the next generation of makers and problem-solvers.

Digitized and preserved for educational and historical reference by Dr. Gene W. Poor, November 2025.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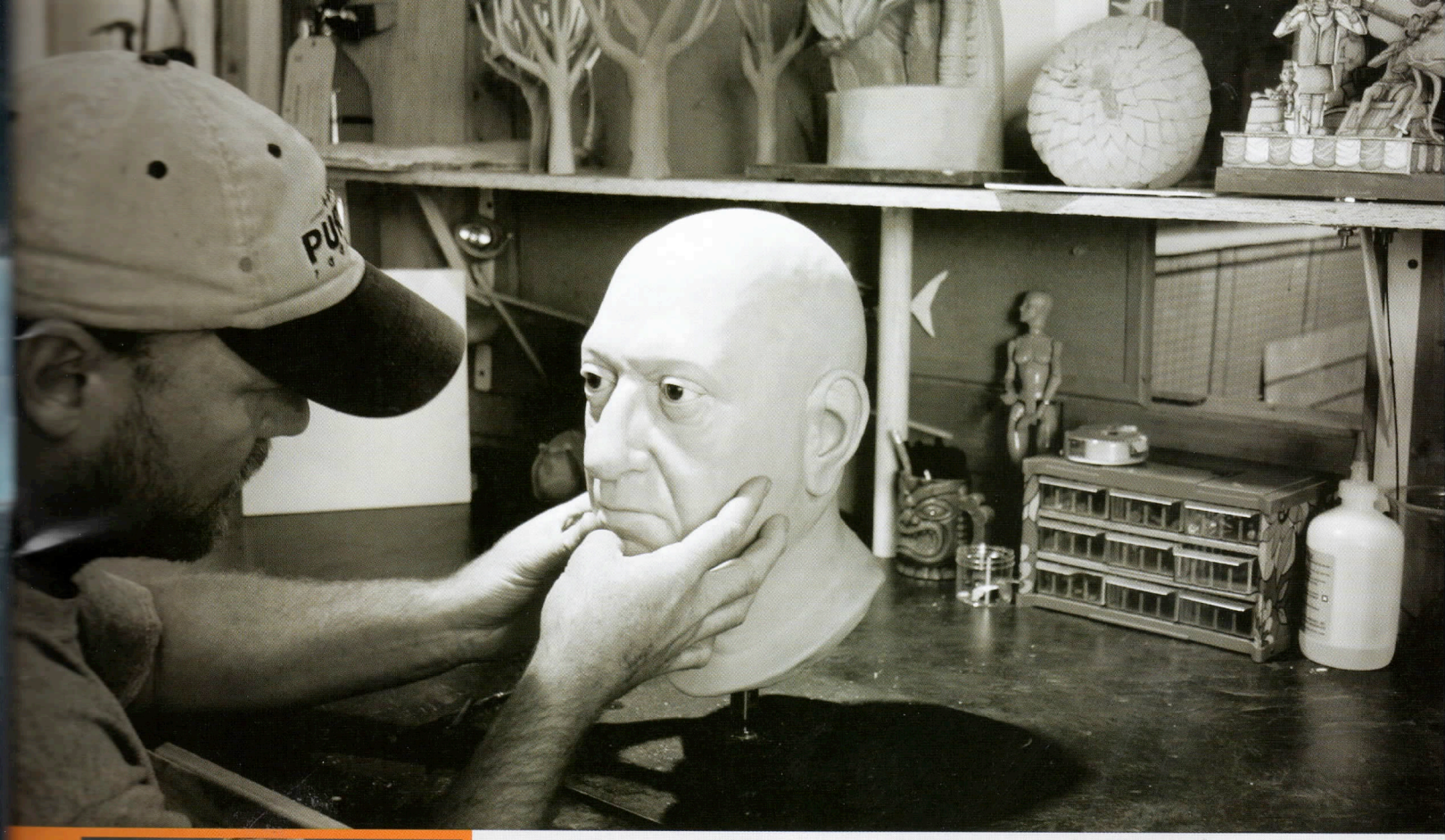
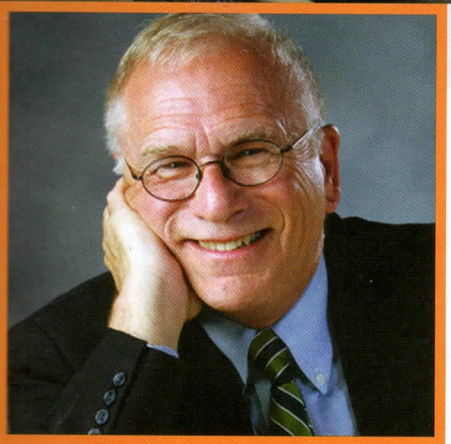


An artist puts the final touches on a clay sculpture. It will be used to mold silicone skin for an animatronic character. Used with permission.



BY DR. GENE WILLIAM POOR

THE ILLUSION OF LIFE:

Lifelike Robotics

Bill Gates recently stated robotics are where computers were 30 years ago. Ponder that thought! Around the world, engineers and scientists are participating in the race to create the first intelligent robot. This new generation of smart robots will act like (and maybe resemble) human beings. Currently, human-like robots (animatronics) are used to teach, sell, entertain, and persuade. Walt Disney imagined the process of creating lifelike robots as the perfect marriage of art and technology. This article examines that art/technology marriage and how creativity plays an integral part of creating the illusion of life.

An artist-craftsman prepares a chair for a Sesame Street ride at Universal Park in Singapore while Ernie supervises. Used with permission.

For thousands of years, humans have been fascinated with machines that give the illusion of life. The word "automaton" generally is used to describe early attempts at reproducing living beings. The word comes from the Greek "automatos," which means "that which moves itself." Very early automatons were water-powered with simple body movements. Later automatons performed one or two predetermined tasks such as drawing a picture or writing a few words. Still later, automatons became complex mechanisms able to perform an entire intricate act, which included such human skills as handstands, flips, rolls, sleight of hands, and illusions of levitation.

The word "robot" first appeared in a 1920 play entitled *Rossum's Universal Robots* (R.U.R.). The Czech author Karel Capek used the word "robot," a derivative of the word "robota," which means "forced labor." In Capek's play, humans create robots to relieve the day-to-day necessity of work. Eventually, humans use robots to fight wars until the robots decide to kill all humans except for the robots' founder. In the play's conclusion, a humanized robot couple walks off into the distance, and "robot-kind" is saved from extinction.

Animatronic characters can say and do things humans can't and shouldn't. Have guts. Get edgy!

The word "robot" eventually replaced automaton and today is found in almost all languages. "Robot" first appeared in *Webster's Dictionary* in 1934, defined there as "any automatic apparatus or device that performs functions ordinarily ascribed to human beings, or operates with what appears to be human intelligence." In subsequent editions of various dictionaries, robots often are described as having humanlike forms.

The Disney Contributions

By the early 1950s, advancements in hydraulics, pneumatics, electronics, and controllers provided an innovator named Walt Disney with his long-sought technology to create lifelike, full-size, three-dimensional animated figures. Disney trademarked his newly created technology "audio-animatronics," which combined audio, animation, and electronics into one descriptive phrase.

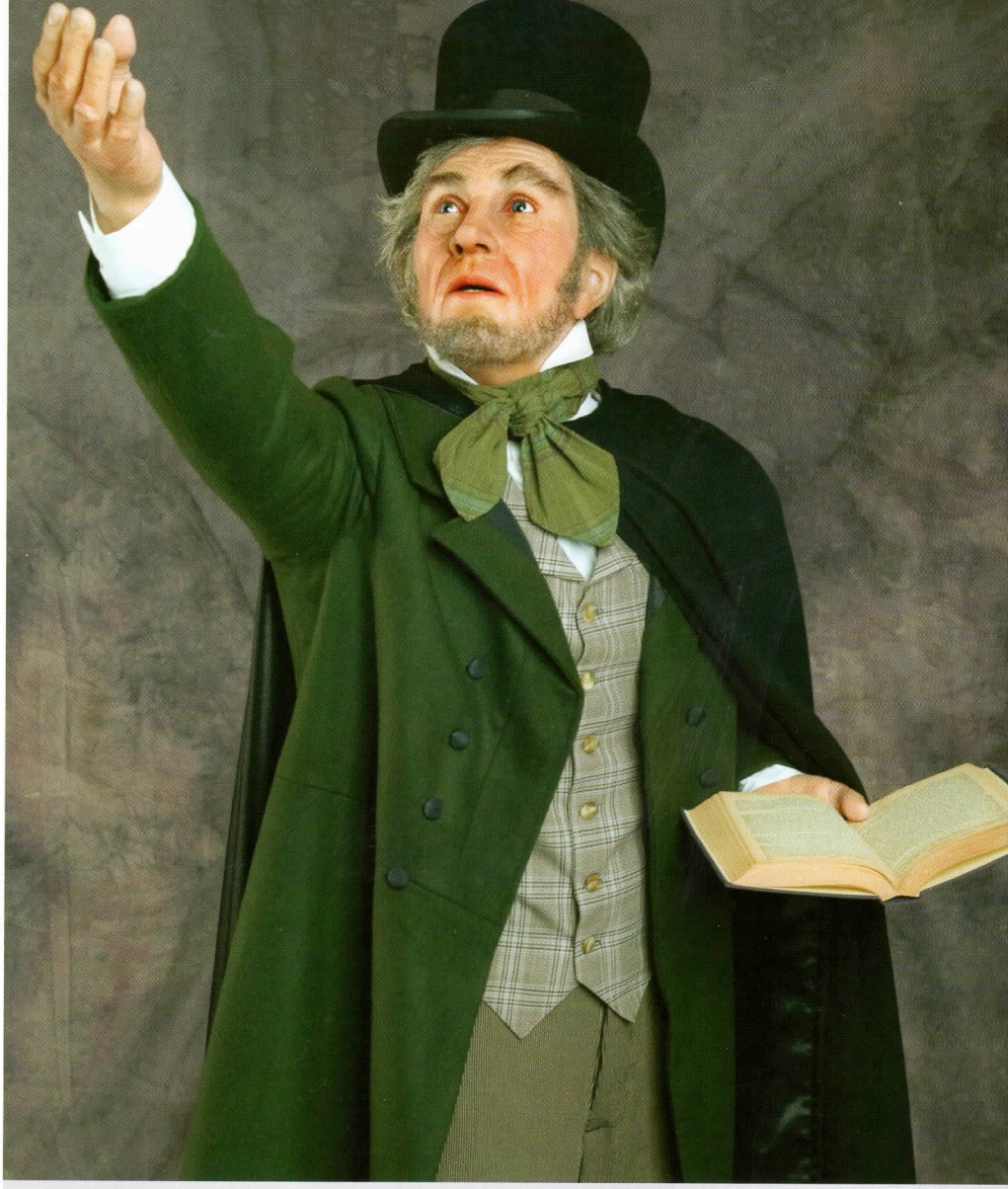
At the 1964 World's Fair in New York, Disney unveiled the first commercial application of lifelike audio-animatronics, the animated character of President Abraham Lincoln. The Illinois Pavilion, where the animated character appeared, became one of the most memorable

exhibits at the fair. After the fair closed, an improved version was built for a similar attraction at Disneyland. Over the years, the attraction evolved into an experience that includes all of the presidents as audio-animatronic characters. Today, sophisticated compliant hydraulic technology enables incredible lifelike movement.

As filmmakers, puppeteers, and animation companies became more involved with the sophisticated technology, they coined the word "animatronics," combining components of animation and electronics. As naturally and smoothly as an animatronic character moves, it has to look realistic first, which remains a major concern of animatronic designers and fabricators.

This notion of realism is what distinguishes an animated character from an industrial robot. The major distinction and focus of industrial robots is how accurately they move, not how lifelike they look. Industrial robots, by their very definition and application, are designed to perform tasks to close tolerances; often those tolerances are within one-thousandth of an inch.

Lifelike animatronic characters, on the other hand, are designed to move like humans. The accuracy of their performance generally is not the primary consideration because they are not designed (or able) to perform precise tasks. They typically exist only to be believable for educational, entertainment, and sales purposes.



An animatronic German minister, Concordia Historical Institute in Clayton, Missouri. Used with permission.

Animatronic Technology

Animatronic characters fall into four categories of movement actuation: mechanical, electrical, pneumatic, and hydraulic. Depending on the particular application, it is not unusual for characters to utilize all these devices to control various movements. However, most lifelike animatronics are built with just one medium of actuation, and pneumatic (air-driven) control is the most common form in the animation industry. Pneumatic actuation is reliable, relatively inexpensive, quiet in operation, easy to maintain, and when compared to hydraulic control (oil), not nearly as messy if a leak occurs.

Unlike humans, lifelike animatronic characters have limited capabilities and are designed only to perform specific tasks. In the design process, the client and the builder establish how many movements are necessary and what those individual movements will be. A move (sometimes referred to as a "degree of freedom") is defined as a simple action an animatronic character can perform such as an eye blink, a foot tap, a head turn, or a wrist bend. Animatronic characters can perform as few as one move (such as a mouth move) or as many as fifty-plus moves.

The simplest movement is a digital (or binary) move. A digital move either is on or off (like a toggle light switch). For example, a digital foot tap moves up, down, or somewhere in between in its travel stroke. The speed movement is preset, and the movement cannot be stopped and held at mid-stroke. The majority of animatronic characters are designed and built with mostly digital moves. These are the least expensive animatronics to build and the easiest to maintain.

An animatronic British soldier, Halifax Historical Society in South Boston, Virginia. Used with permission.

On the other hand, an analog move has more precise control over both the speed and where the move stops along its stroke (such as a dimmer light switch). For example, a head can be turned at virtually any speed and stopped anywhere between its right and left extremes. However, analog moves are more complex and expensive to design, build, and maintain. When budgets allow, designers often include one or two analog moves to give a more human quality to an animatronic character.

A relatively new move control circuit, compliant feedback, occasionally is applied to the analog movement of an animatronic character. Compliant feedback reduces the undesirable shaking or oscillation of an animatronic move when it comes to a complete stop or suddenly changes directions. This shaking problem, known as "boing," is a major concern, especially when a move is fast and has heavy mass such as when moving an animatronic arm. Compliant feedback is achieved electronically by placing a load-sensing cell on the move or within the actuation line, which allows the animatronic character to "give" a little before stopping or reversing direction, hence making the character appear to be more fluid and humanly realistic. Compliant feedback also allows greater movement speed.

Pseudo-analog movement, essentially a digital move configuration with locking positioning devices, offers a third option for controlling animatronic character moves. However, movement speed is typically not controllable, and programming the movement is not as easy as either purely digital or analog moves.

Animatronic Control

Contemporary animatronic controllers are computer-controlled encoder and decoder devices. Some are designed as single, stand-alone units, and others are designed as two separate components. The encoder provides a programming unit that allows the operator to interface with buttons, sliders, joysticks, and rotary switches. Most animatronics are programmed in real time. This means the programmer actually watches the animatronic character perform moves (one or two at a time) while he or she triggers each action in synchronization to a scripted soundtrack. During playback, the decoder interprets those electronic signals generated during the programming session and converts them into appropriate animatronic movements.

Most programmers begin by programming the mouth. To activate mouth movement, the programmer pushes the appropriate button assigned to that particular move in sound synchronization to the mouth opening and closing, much the way a puppeteer would activate a puppet's mouth. Typical programming controllers allow the programmer to "punch-in and punch-out" to make corrections along the way, so the programmer does not

Artists poke individual hairs into the silicone head to create the hairline and eyebrows. Beards and mustaches are created with the same painstaking care. Used with permission.

have to redo the whole sequence to repair a small section.

This programming process continues through the entire animatronic move list, and it can take hours, days, even weeks to complete the process, depending on the complexity of the character, length of the show, number of characters, lighting, and special effects. An animatronic programming session offers the experience of watching a character "come alive" in front of the programmer.

The Design and Build Process

Because they are design-driven, animatronic characters simply can't incorporate all possible human moves, which means the client and manufacturer typically establish what they want the character to do and look like. The desired result may be as simple as "we want a famous character standing next to his invention while describing the process" or as complex as a detailed set of engineered drawings with an exact maquette. In either case, it's a starting point for the dream-versus-budget, tug-of-war process of budgeting.

Scripting, voice talent, and personality are critical to character believability. These components work hand-in-hand to form the character's soul.

Creating an animatronic character is an intricate process that involves many fields of expertise. Disney referred to his audio-animatronics as the "perfect marriage between art and technology." Hence, the incredible skill and craftsmanship involved in making an animatronic character is generally spread through a number of departments: design and engineering, sculpting, mold-making, skin fabrication, painting, adding hair, armature and movement development, plumbing, final assembly, prop and scenic creation, costuming, sound production, special effect development, and programming. All of these departments synchronize through a series of meetings and approval loops between client and manufacturer.

The process begins with a meeting to determine the project objective and audience profile. Establishing the specific purpose of the animatronic character is crucial to assure its ultimate success. During the design process, the client and manufacturer decide on the final appearance, scale, location of the

A control technician programs a character move by move in synchronization to the audio presentation. Used with permission.

moves, and type of moves (analog or digital). Budgets, timelines, checkpoints, and signoffs are all established. Scriptwriting and voice talent selection are also acknowledged and assigned for production. Once solidified, the actual character projects move into production.

The Ten Laws of Animatronics

Animatronic characters that perform successfully are almost always in alignment with some fundamental notions, which can be crafted into ten basic laws:

ONE: The Law of Distance. The greater the distance between audience and animatronic character, the more leeway allowed in believability.

TWO: The Law of Time. The less time a character is viewed, the less sophisticated an animatronic character needs to be.

THREE: The Law of Numbers. The more characters performing or the more movements each character has increases the amount of time the audience pays attention.

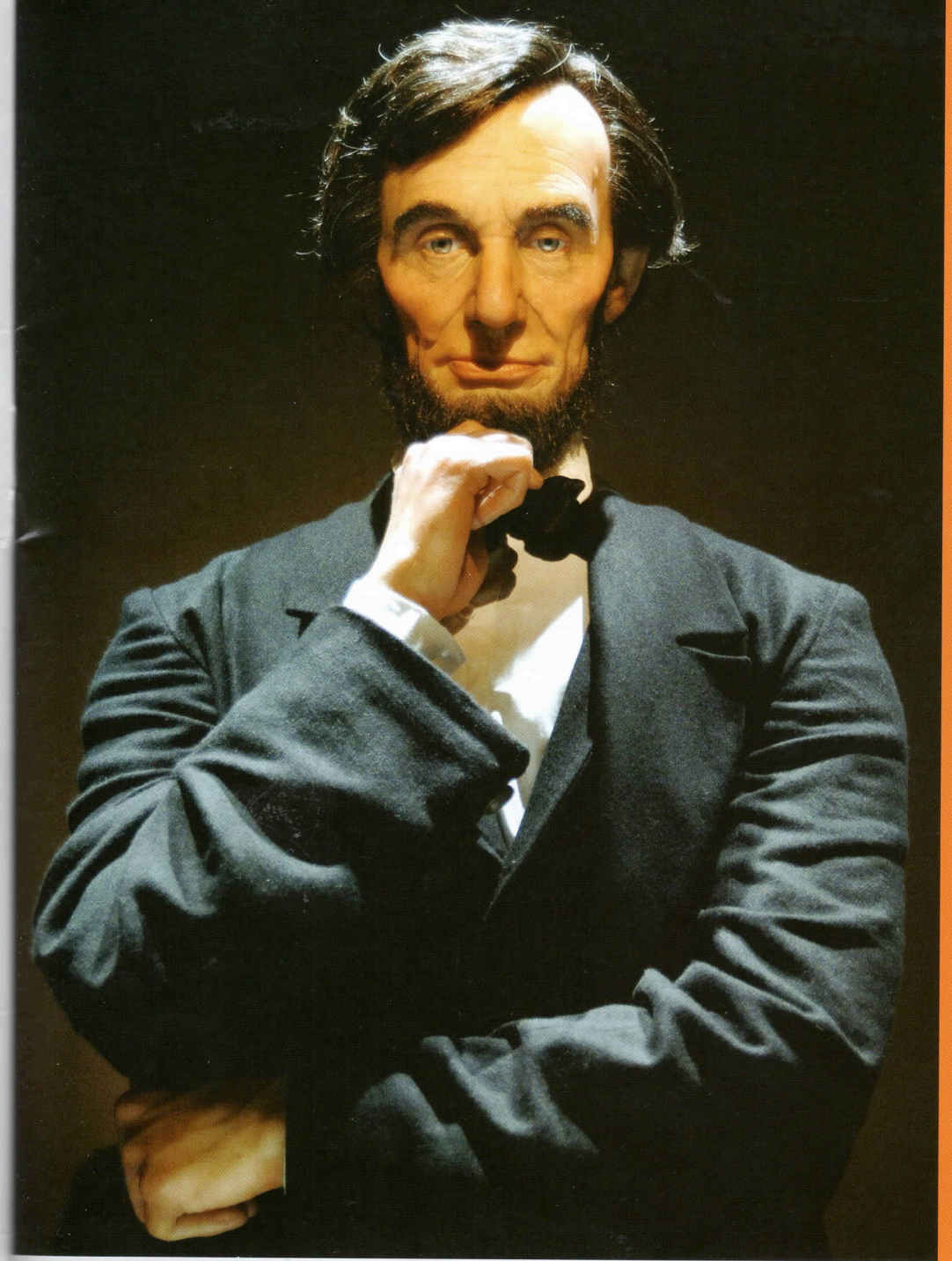
FOUR: The Law of Non-Human. Non-human animatronic characters are not judged as critically as human lifelike ones. None of us really knows what a talking dog or singing chicken looks like.

FIVE: The Law of Surprises. Revelations keep the audience's attention. These surprises can be additional character moves, special effects, or an unusual, clever trick.

SIX: The Law of Singing. Audiences are addicted to animatronic characters that sing. There is something mesmerizing about things that sing but are not human.

SEVEN: The Law of Personality. Scripting, voice talent, and personality are critical to character believability. These components work hand-in-hand to form the character's soul.

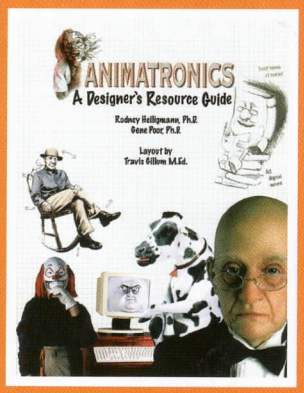
EIGHT: The Law of Brevity. Brevity in performances leaves the audience wanting more. A performance limited to a minute per character is a good starting point that generates curiosity.

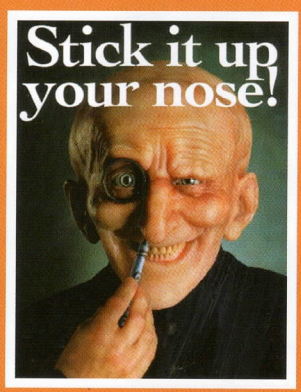


An animatronic President Abraham Lincoln, Lincoln Library and Museum in Springfield, Illinois. Used with permission.

NINE: The Law of Scale. Changing the scale of a thing helps grab attention. For instance, make small things BIG. Consider an animatronic baby as big as a car. Such a sight will definitely stop people in their tracks.

TEN: The Law of the Edge. When possible and appropriate, go over the top with an animatronic character—push the boundaries. Animatronic characters can say and do things humans can't and shouldn't. Have guts. Get edgy!





Dr. Gene Poor is the first Scott Hamilton Endowed Professor of Entrepreneurship in the College of Business Administration at Bowling Green State University and director of the entrepreneur program. He also serves as professor emeritus in the College of Technology, where he conceived and launched the visual communication program. In addition to his academic roles, Dr. Poor also founded LifeFormations—an innovative animatronic company that designs and builds lifelike characters for theme parks, visitor centers, museums, and retail establishments. He has received numerous awards and citations including the Student Alumni Association Master Teacher (considered the highest honor given to BGSU faculty), the Kent State University Distinguished Alumni Award, and the Ernst & Young Entrepreneur of the Year. Dr. Poor has given hundreds of presentations worldwide and written nine books and numerous articles.

For more information, visit

◀ www.lifeformations.com

◀ www.dmacc.edu/ciweek

DR. GENE POOR WILL PRESENT *ANIMATRONICS: THE ILLUSION OF LIFE* AT THE DMACC WEST CAMPUS ON WEDNESDAY, MARCH 6 AT 6:00pm (MAIN STAGE) AND THURSDAY, MARCH 7 AT 8:15am (AUDITORIUM).

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